DECLARATION

I, NOBUAKI KATO, a Japanese Patent Attorney registered No. 8517, of Okabe International Patent Office at No. 602, Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contain a correct translation into English of the priority documents of Japanese Patent Application No. 2000-319718 filed on October 19, 2000 in the name of CANON KABUSHIKI KAISHA.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

signed this 30th day of September, 2005

NOBUAKI KATO

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: October 19, 2000

Application Number: Japanese Patent Application No. 2000-319718

Applicant(s): CANON KABUSHIKI KAISHA

November 9, 2001

Commissioner,
Patent Office KOZO OIKAWA (Seal)

Certificate No. 2001-3098720

2000-319718

[Name of the document]	Patent Application
[Reference No.]	4335014
[Date]	October 19, 2000
[Addressed to]	Commissioner, Patent Office
[International Classification]	H04N 1/00 H04N 9/00
[Title of the Invention]	IMAGE PICKUP APPARATUS, SIGNAL PROCESSING METHOD THEREOF, AND STORAGE MEDIUM HAVING MODULE FOR EXECUTING SIGNAL PROCESSING THEREOF
[Number of the Claims]	39

[Inventor]

[Domicile or Residence]	c/o Canon Kabushiki Kaisha 3-30-2, Shimomaruko, Ohta-ku, Tokyo
[Name]	YOSHITAKA TAKEUCHI

[Applicant]

[Identification No.]	000001007
[Address]	3-30-2, Shimomaruko, Ohta-ku, Tokyo
[Name]	CANON KABUSHIKI KAISHA
[Representative]	FUJIO MITARAI

[Attorney]

[Identification No.]	100066061
[Address]	1-18-16, Shinbashi, Minato-ku, Tokyo

[Patent Attorney]

[Name]	HIROYUKI NIWA
[Telephone No.]	03(3503)2821

[Elected Attorney]

[Identification No.] 100094754

[Address] 1-18-16, Shinbashi, Minato-ku, Tokyo

[Patent Attorney]

[Name] TADAO NOGUCHI

[Telephone No.] 03(3503)2821

[Indication of Official Fee]

[Prepayment Ledger No.] 011707

[Amount] 21000

[List of Filed Materials]

[Material] Specification 1

[Material] Drawings 1

[Material] Abstract 1

[General Power of Attorney] 9703800

[Proof Requirement] Required

2000-319718

[Name of the Document] Specification

[Title of the Invention] Image Pickup Apparatus, Signal Processing Method Thereof, And Storage Medium Having Module For Executing Signal Processing Thereof

[What is Claimed is]

[Claim 1]

An image pickup apparatus comprising:

storage means for converting each image pickup data obtained by image pickup means into a file to be stored in a storage medium, and for storing control data in an area different from an area of each file in which said image pickup data is stored.

[Claim 2]

An image pickup apparatus according to Claim 1, further comprising:

monitor means for reproducing and displaying said image pickup data which has been converted into a file and stored;

selection means for selecting a desired image pickup data by using said monitor means;

read-out means for reading out, when the image pickup data is selected by said selection means, control data which is stored in the same file as that storing the selected image pickup data; and

reproduction means for reproducing said read-out image pickup data on the basis of said read-out data.

[Claim 3]

An image pickup apparatus according to Claim 1, wherein said control data includes white balance control data.

[Claim 4]

An image pickup apparatus according to Claim 1, wherein said control data includes color balance control data.

[Claim 5]

An image pickup apparatus according to Claim 1, wherein said control data is a representative value of each color component data of all or a part of the image pickup data obtained by said image pickup means or an average value of said each color component.

[Claim 6]

An image pickup apparatus according to Claim 5, further comprising operation means for calculating, from a ratio of each color component of said read-out control data, a reciprocal number thereof.

[Claim 7]

An image pickup apparatus according to Claim 3, further comprising white balance adjustment means for performing white balance adjustment of the image pickup data read-out from said storage medium on the basis of said white balance control data.

[Claim 8]

An image pickup apparatus according to Claim 1, wherein said control data is stored in an attached area in each file.

[Claim 9]

An image pickup apparatus according to Claim 1, wherein the image pickup data obtained by the image pickup means is matrix-converted into a luminance signal and two cooler difference signals after the white balance adjustment is performed, to be encoded into a file with predetermined specification and stored in a storage medium, and the representative value of each color component data or the average value data of each color component is stored in an attached area in the same file as that storing said image pickup data.

[Claim 10]

An image pickup apparatus according to any one of Claims 1, 3 and 4, wherein said control data includes data specific to an image pickup element included in said image pickup means.

[Claim 11]

An image pickup apparatus according to Claim 1, wherein said storage means is detachably attached to said image pickup apparatus.

[Claim 12]

An image pickup apparatus comprising:

image pickup means provided with a plurality of

color filters having different spectroscopic characteristics;

white balance adjustment means for performing white balance adjustment of the image pickup data obtained by said image pickup means;

color balance adjustment means for performing color balance adjustment of the image pickup data adjusted by said white balance adjustment;

recording means for converting each image pickup data adjusted by said color balance adjustment into a file to be stored in a recording medium, and for recording a representative value of each color component data or an average value data of each color component for all or a part of the image pickup data which is originally obtained by said image pickup means in an area of each file different from an area for storing said image pickup data adjusted by the color balance adjustment;

monitor means for reproducing and displaying said image pickup data which has been converted into a file and stored;

first selection means for selecting desired image pickup data by using said monitor means;

read-out means for reading out, when the image pickup data is selected by said first selection means, the data of said representative value or said average value which is stored in the same file as that storing this image pickup data;

first operation means for calculating a control value for said white balance adjustment means on the basis of said read-out data;

second operation means for calculating a control value for said color balance adjustment means on the basis of said read-out data;

second selection means for selecting whether said read-out data is used as a control value for said white balance adjustment means or a control value for said color balance adjustment means; and

setting means for setting a control value which is selected by said second selection means and calculated,

wherein the white balance adjustment or the color balance adjustment is performed by the use of the control value set by said setting means.

[Claim 13]

An image pickup apparatus according to Claim 12, wherein the first operation means calculates a ratio of each color component of said read-out data, and a reciprocal number thereof.

[Claim 14]

An image pickup apparatus according to Claim 12 or 13, wherein the white balance adjustment means performs white balance adjustment by multiplying the set control value by each color component of the image pickup data obtained by the image pickup means.

[Claim 15]

An image pickup apparatus according to any one of Claims 12 to 14, wherein the second operation means calculates a ratio of each color component of the read-out data.

[Claim 16]

An image pickup apparatus according to any one of Claims 12 to 15, wherein the color balance adjustment means performs color balance adjustment by multiplying the control value by each color component of the image pickup data adjusted by the white balance adjustment.

[Claim 17]

An image pickup apparatus comprising:

image pickup means provided with a plurality of color filters having different spectroscopic characteristics;

first adjustment means for performing white balance adjustment or color balance adjustment of the image pickup data obtained by said image pickup means;

a memory for storing image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus;

recording means for converting each image pickup data adjusted by said white balance adjustment or said color balance adjustment into a file to be stored in a recording medium, and for recording a representative value of each

color component data or an average value data of each color component for all or a part of the image pickup data which is originally obtained by said image pickup means, image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, and image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus stored in said memory, in an area of each file different from an area for storing said image pickup data adjusted by the white balance adjustment or the color balance adjustment;

monitor means for reproducing and displaying said image pickup data which has been converted into a file and stored;

selection means for selecting desired image pickup data by using said monitor means;

first read-out means for reading out, when image pickup data is selected by said selection means, said representative value or said average value data which is stored in the same file as that storing this image pickup data, and the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are stored in the same file;

second read-out means for reading out the image

pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are stored in said memory;

second adjustment means for adjusting the representative value or the average value data read-out by said first read-out means on the basis of the image pickup data for each color component data with respect to the specific plural light sources picked up by a referential image pickup apparatus, the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are read-out by said first read-out means, the image pickup data for each color component data with respect to the specific plural light sources picked up by a referential image pickup apparatus, and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are read-out by said second read-out means;

operation means for calculating a control value for said first adjustment means on the basis of said representative value or said average value data adjusted by said second adjustment means; and

setting means for setting the control value which is operated by said operation means,

wherein said first adjustment means performs the white balance adjustment or the color balance adjustment by the use of the control value set by said setting means.

[Claim 18]

An image pickup apparatus according to Claim 17, wherein the operation means calculates a ratio of each color component of the adjusted data of the representative value or the average data or a reciprocal number of the ratio.

[Claim 19]

An image pickup apparatus according to Claim 17 or 18, wherein the first adjustments means performs the white balance adjustment or the color balance adjustment by multiplying the set control value by each color component of the image pickup data obtained by the image pickup means.

[Claim 20]

A signal processing method of an image pickup apparatus comprising:

a storing step of converting each image pickup data obtained in an image pickup step into a file to be stored in a storage medium and, storing a control data in an area of the file different from an area storing said image pickup data.

[Claim 21]

A signal processing method according to Claim 20, wherein said control data includes white balance control data.

[Claim 22]

An signal processing method according to Claim 20, wherein said control data includes color balance control data.

[Claim 23]

A signal processing method according to Claim 20, wherein said control data is a representative value of each color component data with respect to all or a part of the image pickup data obtained by said image pickup means or an average value of said each color component.

[Claim 24]

A signal processing method according to Claim 21, further comprising white balance adjustment means for performing white balance adjustment of the image pickup data read-out from said storage medium on the basis of said white balance control data.

[Claim 25]

A signal processing method according according to Claim 20, wherein said control data is stored in an attached area in each file.

[Claim 26]

A signal processing method according according to Claim 20, wherein the image pickup data obtained in the image pickup step is matrix-converted into a luminance signal and two cooler difference signals after the white balance adjustment is performed to be encoded into a file with predetermined specification and stored in a storage medium, and the representative value of each color component data

or the average value data for each color component is stored in an attached area in the same file as that storing said image pickup data.

[Claim 27]

A signal processing method according to any one of Claims 20, 22 and 23, wherein said control data includes data specific to an image pickup element included in said image pickup means.

[Claim 28]

A signal processing method according to Claim 20, wherein said storage means is detachably attached to said image pickup apparatus.

[Claim 29]

A signal processing method of an image pickup apparatus comprising the steps of:

performing white balance adjustment of image pickup data which is obtained by image pickup means provided with a plurality of color filters having different spectroscopic characteristics by the use of white balance adjustment means;

performing color balance adjustment of the image pickup data adjusted by said white balance adjustment by the use of color balance adjustment means;

converting each image pickup data adjusted by said color balance adjustment into a file to be stored in a recording medium and recording a representative value of each color component data or an average value data of each color component for all or a part of the image pickup data

which is originally obtained by said image pickup means in an area of each file different from an area for recording said image pickup data adjusted by the color balance adjustment;

reading out, when desired image pickup data is selected by the use of monitor means for reproducing and displaying said image pickup data which has been converted into a file and stored, said representative value or said average value data which is stored in the same file as that storing this image pickup data;

calculating a control value for said white balance adjustment means or a control value for said color balance adjustment means on the basis of said read-out data;

setting a control value which is calculated by selecting whether said read-out data is used as a control value for said white balance adjustment means or as a control value for said color balance adjustment means; and

performing the white balance adjustment or the color balance adjustment by the use of said set control value.

[Claim 30]

A signal processing method of an image pickup apparatus comprising the steps of:

performing white balance adjustment or color balance adjustment of the image pickup data obtained by image pickup means provided with a plurality of color filters having different spectroscopic characteristics by the use of first adjustment means;

storing image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus in a memory;

converting each image pickup data adjusted by said white balance adjustment or said color balance adjustment into a file to be stored in a recording medium and recording a representative value of each color component data or an average value data of each color component for all or a part of the image pickup data which is originally obtained by said image pickup means, the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus recorded in said memory in an area of each file different from an area storing said image pickup data adjusted by the white balance adjustment or the color balance adjustment;

reading out, when desired image pickup data is selected by the use of monitor means for reproducing and displaying said image pickup data which has been converted into a file and stored, said representative value or said average value data which is stored in the same file as that storing this image pickup data, and the image pickup data

for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are recorded in the same file by the use of first read-out means;

reading out the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are stored in said memory by the use of second read-out means;

adjusting said representative value or said average value data read out by said first read-out means on the basis of the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are read out by said first read-out means, the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, and the image pickup data for each color component data with respect to said specific plural light sources intrinsic to the image pickup apparatus which are read out by said second read-out means

by the use of second adjustment means;

calculating a control value for said first adjustment means on the basis of said representative value or said average value data adjusted by said second adjustment means;

setting said calculated control value; and

performing the white balance adjustment or the color balance adjustment by the use of the control value set by said first adjustment means.

[Claim 31]

A storage medium for storing a module comprising:

a storing step for converting each image pickup data obtained at the image pickup step into a file to be stored in the storage medium and for storing a control data in an area of each file different from an area storing said image pickup data.

[Claim 32]

A storage medium according to Claim 31, wherein said control data includes white balance control data.

[Claim 33]

A storage medium according to Claim 31, wherein said control data includes color balance control data.

[Claim 34]

A storage medium according to Claim 31, wherein said control data is a representative value of each color component data with respect to all or a part of the image pickup data obtained by said image pickup means or an average value of said each color component.

[Claim 35]

A storage medium according to Claim 32, further comprising white balance adjustment means for performing white balance adjustment of the image pickup data read out from said storage medium.

[Claim 36]

A storage medium according to Claim 31, wherein said control data is stored in an attached area in each file.

[Claim 37]

A storage medium according to Claim 31, wherein the image pickup data obtained at said image pickup step is matrix-converted into a luminance signal and two cooler difference signals after the white balance adjustment is performed to be encoded into a file with predetermined specification and stored in a storage medium, and the representative value of each color component data or the average value data of each color component is stored in an attached area in the same file as that storing said image pickup data.

[Claim 38]

A storage medium according to any one of Claims 31, 33 and 34, wherein said control data includes data specific to an image pickup element included in said image pickup means.

[Claim 39]

A storage medium according to Claim 31, wherein

said storage means is detachably attached to said image pickup apparatus.

[Detailed Description of the Invention]

[0001]

[Field of the Industrial Utilization]

The present invention relates to an image pickup apparatus for adjusting tone of image data picked up by image pickup means having a plurality of color filters, a signal processing method thereof and a storage medium having a module for executing the signal processing.

[0002]

[Prior Art]

To output image data picked up by an image pickup element having a plurality of color filters, the picked-up image data undergoes white balance adjustment, and the color temperature of a light source in the picked-up image so that the image is adjusted to be achromatic, thereby performing faithful color reproduction of the picked-up image.

[0003]

The white balance adjustment methods include a method of determining the color temperature of a light source using a calorimetric element and a method of searching for an achromatic portion in the picked-up image and determining the color temperature of the achromatic portion. These methods, however, cannot accurately adjust the white balance due to detection errors of colors of the light sources.

[0004]

As one of the most accurate white balance adjustment methods, a white balance adjustment method is available in which an achromatic object is picked up (this operation is called white sheet image pickup), a control value is obtained so as to equalize the magnitudes of color components of the picked-up image, and white balance adjustment is performed for the subsequent image pickup using the control value. This white balance adjustment method will be referred to as a manual white balance (MWB) hereinafter.

[0005]

A conventional MWB control method using white sheet image pickup is shown in Fig. 11. Fig. 11 shows the conventional white balance adjustment method of partially extracting data (to be referred to white sheet data hereinafter) from an achromatic image (to be referred to as a white sheet image hereinafter) picked up by image pickup means having a plurality of color filters, recording the extracted white sheet data on a recording medium, reading the white sheet data from the medium in the subsequent image pickup to calculate a white balance control value, and adjusting the white balance using the calculated control value.

[0006]

Each of the plurality of color filters of the image pickup element is made up of primary colors of R, G1, G2, and B, as shown in Fig. 5. Image pickup data input from

an image pickup data input terminal 1001 is processed by a main image processing unit 1002, encoding processing unit 1003, and image filing unit 1004. The processed data is recorded on a recording medium as image data by a medium-recording unit 1005.

[0007]

Independently of this normal image recording process, part of the image pickup data is extracted by an image data extraction unit as MWB white sheet data. The extracted MWB white sheet data is recorded in the MWB data area of the recording medium.

[0008]

When the white balance mode is set in the MWB in the subsequent image pickup, a medium-reproduction unit 1007 in the image pickup apparatus reproduces the white data recorded on the medium. A white balance control value read-out unit 1008 reads out the white data. A white balance control value operating unit 1009 calculates the R, G1, G2, and B white balance control values so as to equalize the magnitudes of the average values of the R, G1, G2, and B color signals of the white data.

[0009]

The white balance control values obtained by the white balance control value operating unit 1009 are set for white balance adjustment of the image pickup apparatus by a white balance control value setting unit 1010. Using the set control values, a white balance adjustment unit

1014 adjusts the white balance of the image pickup data input from an image pickup data input terminal 1013 in the subsequent image pickup. A color processing unit 1015 performs final color adjustment such as conversion of a color matrix or color correction processing. An encoding processing unit 1016 encodes the color-adjusted data into a recording format. The data output from the encoding processing unit 1016 is converted into a recording file by an image filing unit 1017. The resultant file is recorded on a recording medium 1018 as a pickup image file.

[0010]

As shown in Fig. 12, in the MWB mode, a white balance control value operating unit 1102 directly calculates white balance control values from the white sheet data picked up by an image pickup apparatus (input from an image pickup data input terminal 1101). The calculated control values are set in the image pickup apparatus by a white balance control value setting unit 1103 and used as the control values in subsequent image pickup for a white balance adjustment unit 1114.

[0011]

By using the set control values, the white balance adjustment unit 1114 adjusts the white balance of the image pickup data input from an image pickup data input terminal 1113 in the subsequent image pickup. A color processing unit 1115 performs final color adjustment such as color matrix conversion and color correction processing. An

output from the color processing unit 1115 is encoded into a recording format by an encoding processing unit 1116. An output from the encoding processing unit 1116 is converted into a recording file by an image filing unit 1117. The resultant file is recorded on a recording medium 1118 as a pickup image file.

[0012]

[Problems to be Solved by the Invention]

In the prior arts described above, however, white sheet data is written in a specific area called the MWB data area of a recording medium. The recording medium is inserted into an image pickup apparatus to read out the white data in the MWB mode. It is difficult to store a plurality of types of MWB white sheet data on one recording medium, manage them, and read out desired white data. The white data cannot be conveniently used.

[0013]

The method of directly calculating the white balance control values upon picking up image pickup data and setting them in the image pickup apparatus cannot set an another MWB mode when the white data is prepared once and continuously used, resulting in inconvenience. The white data cannot be conveniently used either.

[0014]

When white sheet data picked up by a given image pickup apparatus is used as white data for another image pickup apparatus in the above system, accurate white balance

adjustment cannot be performed due to the influence of variations in spectral characteristics of the image pickup elements. The white sheet data cannot be conveniently used either.

[0015]

The present invention has been made in consideration of the conventional problems described above, and has its object to provide an image pickup apparatus in which white sheet data used for color correction of a picked-up image can be conveniently used, a signal processing method for the image pickup apparatus, and a recording medium having a module for executing the signal processing of the signal processing method.

[0016]

[Means for Solving the Problems]

An image pickup apparatus, a signal processing method thereof, and a storage medium having a module for executing a signal processing thereof according to the present invention are arranged as follows.

[0017]

(1) There is provided an image pickup apparatus comprising storage means for converting each image pickup data obtained by image pickup means into a file to be stored in a storage medium, and for storing control data in an area of each file different from an area in which the image pickup data is stored.

[0018]

(2) The image pickup apparatus set forth in the above (1) further comprises: monitor means for reproducing and displaying the image pickup data which has been converted into a file and stored; selection means for selecting a desired image pickup data by using the monitor means; read-out means for reading out, when the image pickup data is selected by the selection means, control data which is stored in the same file as that storing the selected image pickup data; and reproduction means for reproducing the read-out image pickup data on the basis of the read-out data.

[0019]

(3) In the image pickup apparatus set forth in the above (1), the control data includes white balance control data.

[0020]

(4) In the image pickup apparatus set forth in the above (1), the control data includes color balance control data.

[0021]

(5) In the image pickup apparatus set forth in the above (1), the control data is a representative value of each color component data of all or a part of the image pickup data obtained by the image pickup means or an average value of the each color component.

[0022]

(6) The image pickup apparatus set forth in the above (5) further comprises operation means for calculating,

from a ratio of each color component of the read-out control data, a reciprocal number thereof.

[0023]

(7) The image pickup apparatus set forth in the above (3) further comprises white balance adjustment means for performing white balance adjustment of the image pickup data read-out from the storage medium on the basis of the white balance control data.

[0024]

(8) In the image pickup apparatus set forth in the above (1), the control data is stored in an attached area in each file.

[0025]

(9) In the image pickup apparatus set forth in the above (1), the image pickup data obtained by the image pickup means is matrix-converted into a luminance signal and two cooler difference signals after the white balance adjustment is performed, to be encoded into a file with predetermined specification and stored in a storage medium, and the representative value of each color component data or the average value data of each color component is stored in an attached area in the same file as that storing the image pickup data.

[0026]

(10) In the image pickup apparatus set forth in any one of the above (1), (3) and (4), the control data includes data specific to an image pickup element included

in the image pickup means.

[0027]

(11) In the image pickup apparatus set forth in the above (1), the storage means is detachably attached to the image pickup apparatus.

[0028]

(12) There is provided an image pickup apparatus comprising: image pickup means provided with a plurality of color filters having different spectroscopic characteristics; white balance adjustment means for performing white balance adjustment of the image pickup data obtained by the image pickup means; color balance adjustment means for performing color balance adjustment of the image pickup data adjusted by the white balance adjustment; recording means for converting each image pickup data adjusted by the color balance adjustment into a file to be stored in a recording medium, and for recording a representative value of each color component data or an average value data of each color component for all or a part of the image pickup data which is originally obtained by the image pickup means in an area of each file different from an area for storing the image pickup data adjusted by the color balance adjustment; monitor means for reproducing and displaying the image pickup data which has been converted into a file and stored; first selection means for selecting desired image pickup data by using the monitor means; read-out means for reading out, when the image pickup

data is selected by the first selection means, the data of the representative value or the average value which is stored in the same file as that storing this image pickup data; first operation means for calculating a control value for the white balance adjustment means on the basis of the read-out data; second operation means for calculating a control value for the color balance adjustment means on the basis of the read-out data; second selection means for selecting whether the read-out data is used as a control value for the white balance adjustment means or a control value for the color balance adjustment means; and setting means for setting a control value which is selected by the second selection means and calculated, so that the white balance adjustment or the color balance adjustment is performed by the use of the control value set by the setting means.

[0029]

(13) In the image pickup apparatus set forth in the above (12), the first operation means calculates a ratio of each color component of the read-out data, and a reciprocal number thereof.

[0030]

(14) In the image pickup apparatus set forth in the above (12) or (13), the white balance adjustment means performs white balance adjustment by multiplying the set control value by each color component of the image pickup data obtained by the image pickup means.

[0031]

(15) In the image pickup apparatus set forth in any one of the above (12) to (14), the second operation means is to calculates a ratio of each color component of the read-out data.

[0032]

(16) In the image pickup apparatus set forth in any one of the above (12) to (15), the color balance adjustment means performs color balance adjustment by multiplying the control value by each color component of the image pickup data adjusted by the white balance adjustment.

[0033]

(17) There is provided an image pickup apparatus comprising: image pickup means provided with a plurality of color filters having different spectroscopic characteristics; first adjustment means for performing white balance adjustment or color balance adjustment of the image pickup data obtained by the image pickup means; a memory for storing image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus; recording means for converting each image pickup data adjusted by the white balance adjustment or the color balance adjustment into a file to be stored in a recording medium, and for recording a representative value of each color

component data or an average value data of each color component for all or a part of the image pickup data which is originally obtained by the image pickup means, image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, and image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus stored in the memory, in an area of each file different from an area for storing the image pickup data adjusted by the white balance adjustment or the color balance adjustment; monitor means for reproducing and displaying the image pickup data which has been converted into a file and stored; selection means for selecting desired image pickup data by using the monitor means; first read-out means for reading out, when image pickup data is selected by the selection means, the representative value or the average value data which is stored in the same file as that storing this image pickup data, and the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are stored in the same file; second read-out means for reading out the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup

apparatus and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are stored in the memory; second adjustment means for adjusting the representative value or the average value data read-out by the first read-out means on the basis of the image pickup data for each color component data with respect to the specific plural light sources picked up by a referential image pickup apparatus, the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are read-out by the first read-out means, the image pickup data for each color component data with respect to the specific plural light sources picked up by a referential image pickup apparatus, and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are read-out by the second read-out means; operation means for calculating a control value for the first adjustment means on the basis of the representative value or the average value data adjusted by the second adjustment means; and setting means for setting the control value which is operated by the operation means, so that the first adjustment means performs the white balance adjustment or the color balance adjustment by the use of the control value set by the setting means.

[0034]

(18) In the image pickup apparatus set forth in

the above (17), the operation means calculates a ratio of each color component of the adjusted data of the representative value or the average data or a reciprocal number of the ratio.

[0035]

(19) In the image pickup apparatus set forth in the above (17) or (18), the first adjustments means performs the white balance adjustment or the color balance adjustment by multiplying the set control value by each color component of the image pickup data obtained by the image pickup means.

[0036]

(20) There is provided a signal processing method of an image pickup apparatus comprising: a storing step of converting each image pickup data obtained in an image pickup step into a file to be stored in a storage medium and, of storing a control data in an area different from an area storing the image pickup data of the file.

[0037]

(21) In the signal processing method set forth in the above (20), the control includes white balance control data.

[0038]

(22) In the signal processing method set forth in the above (20), the control data includes color balance control data.

[0039]

(23) In the signal processing method set forth

in the above (20), the control data is a representative value of each color component data with respect to all or a part of the image pickup data obtained by the image pickup means or an average value of the each color component.

[0040]

(24) The signal processing method set forth in the above (21) further comprises white balance adjustment means for performing white balance adjustment of the image pickup data read-out from the storage medium on the basis of the white balance control data.

[0041]

(25) In the signal processing method set forth in the above (20), the control data is stored in an attached area in each file.

[0042]

(26) In the signal processing method set forth in the above (20), the image pickup data obtained in the image pickup step is matrix-converted into a luminance signal and two cooler difference signals after the white balance adjustment is performed to be encoded into a file with predetermined specification and stored in a storage medium, and the representative value of each color component data or the average value data for each color component is stored in an attached area in the same file as that storing the image pickup data.

[0043]

(27) In the signal processing method set forth

in any one of the above (20), (22) and (23), the control data includes data specific to an image pickup element included in the image pickup means.

(28) In the signal processing method set forth in the above (20), the storage means is detachably attached to the image pickup apparatus.

[0044]

(29) There is provided a signal processing method of an image pickup apparatus comprising the steps of: performing white balance adjustment of image pickup data which is obtained by image pickup means provided with a plurality of color filters having different spectroscopic characteristics by the use of white balance adjustment means; performing color balance adjustment of the image pickup data adjusted by the white balance adjustment by the use of color balance adjustment means; converting each image pickup data adjusted by the color balance adjustment into a file to be stored in a recording medium and recording a representative value of each color component data or an average value data of each color component for all or a part of the image pickup data which is originally obtained by the image pickup means in an area of each file different from an area for recording the image pickup data adjusted by the color balance adjustment; reading out, when desired image pickup data is selected by the use of monitor means for reproducing and displaying the image pickup data which has been converted into a file and stored, the representative

value or the average value data which is stored in the same file as that storing this image pickup data; calculating a control value for the white balance adjustment means or a control value for the color balance adjustment means on the basis of the read-out data; setting a control value which is calculated by selecting whether the read-out data is used as a control value for the white balance adjustment means or as a control value for the color balance adjustment means; and performing the white balance adjustment or the color balance adjustment by the use of the set control value. [0045]

(30) There is provided a signal processing method of an image pickup apparatus comprising the steps of: performing white balance adjustment or color balance adjustment of the image pickup data obtained by image pickup means provided with a plurality of color filters having different spectroscopic characteristics by the use of first adjustment means; storing image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus in a memory; converting each image pickup data adjusted by the white balance adjustment or the color balance adjustment into a file to be stored in a recording medium and recording a representative value of each color component data or an average value data of each color component

for all or a part of the image pickup data which is originally obtained by the image pickup means, the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus recorded in the memory in an area of each file different from an area storing the image pickup data adjusted by the white balance adjustment or the color balance adjustment; reading out, when desired image pickup data is selected by the use of monitor means for reproducing and displaying the image pickup data which has been converted into a file and stored, the representative value or the average value data which is stored in the same file as that storing this image pickup data, and the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are recorded in the same file by the use of first read-out means; reading out the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are stored in the memory by the use

of second read-out means; adjusting the representative value or the average value data read out by the first read-out means on the basis of the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are read out by the first read-out means, the image pickup data for each color component data with respect to specific plural light sources picked up by a referential image pickup apparatus, and the image pickup data for each color component data with respect to the specific plural light sources intrinsic to the image pickup apparatus which are read out by the second read-out means by the use of second adjustment means; calculating a control value for the first adjustment means on the basis of the representative value or the average value data adjusted by the second adjustment means; setting the calculated control value; and performing the white balance adjustment or the color balance adjustment by the use of the control value set by the first adjustment means.

[0046]

(31) There is provided a storage medium for storing a module comprising: a storing step for converting each image pickup data obtained at the image pickup step into a file to be stored in the storage medium and for storing a control data in an area of each file different from an

area storing the image pickup data.

[0047]

(32) In the storage medium set forth in the above (31), the control data includes white balance control data.

[0048]

(33) In the storage medium set forth in the above (31), the control data includes color balance control data.

[0049]

(34) In the storage medium set forth in the above (31), the control data is a representative value of each color component data with respect to all or a part of the image pickup data obtained by the image pickup means or an average value of the each color component.

[0050]

(35) The storage medium set forth in the above (32) further comprises white balance adjustment means for performing white balance adjustment of the image pickup data read out from the storage medium.

[0051]

(36) In the storage medium set forth in the above (31), the control data is stored in an attached area in each file.

[0052]

(37) In the storage medium set forth in the above (31), the image pickup data obtained at the image pickup step is matrix-converted into a luminance signal and two cooler difference signals after the white balance adjustment

is performed to be encoded into a file with predetermined specification and stored in a storage medium, and the representative value of each color component data or the average value data of each color component is stored in an attached area in the same file as that storing the image pickup data.

[0053]

(38) In the storage medium set forth in any one of the above (31), (33) and (34), the control data includes data specific to an image pickup element included in the image pickup means.

[0054]

(39) In the storage medium set forth in the above (31), the storage means is detachably attached to the image pickup apparatus.

[0055]

[Detailed Description of the Preferred Embodiments]

(First Embodiment)

Fig. 1 is a block diagram showing the main part of an image pickup apparatus according to the first embodiment. This embodiment will exemplify a method of recording a part of image pickup data as white sheet data into an attached data area of each image file when each pickup image is recorded on a recording medium.

[0056]

Referring to Fig. 1, an image pickup data input terminal 101 receives image pickup data obtained by an image

pickup element having four, R, G1, G2, and B, color filters and converted into digital data.

[0057]

This image pickup data is processed in a main image processing unit 102 for various image processing operations for recording with high image quality as in a digital image recording apparatus (image pickup apparatus) such as a general digital camera. The processed image pickup data is then encoded by an encoding processing unit 103 in accordance with a JPEG recording format.

[0058]

On the other hand, a part of image pickup data, e.g., pixel data of 64 pixels in the central portion of the two-dimensional image space of one picture is extracted by a white sheet data extraction unit 104, as shown in Fig. 9. An averaging processing unit 105 obtains an average value of 16-pixel data of each color component signal of R, G1, G2, or B.

[0059]

An image filing unit 106 forms an image file together with the original encoded image data. The average value is allocated to an area attached to the predetermined MWB white sheet data of the image file, and is recorded by a medium recording unit 107 as one image file together with the original encoded image data.

[0060]

The above-described operation is inevitably

performed at every image picking up operation including a general image picking up operation. In the same manner, the white sheet image picking up operation is performed as one of the general image picking up operation. Since the white sheet data is obtained by extracting an image of 64 pixels in the central portion of the picture, any color image except white such as a white sheet can be picked up around the 64-pixel area.

[0061]

A technique for setting a white balance control value in the MWB mode in the image pickup apparatus will be described below. A medium on which an image file is recorded by the above recording scheme is loaded in the image pickup apparatus, and image file reproduction is done using a user interface shown in Fig. 7.

[0062]

A PLAY button 703 shown in Fig. 7 is depressed to reproduce and display this image data (image pickup data) of the image file on a reproduction monitor 701.

[0063]

The operator sequentially switches a plurality of files with file selection switches 704 and 705 while viewing the reproduction monitor 701 and selects one image file to be used in MWB.

[0064]

When an image file is reproduced and monitored, the white sheet data is also read out from an attached white

sheet data area by a white sheet data reproduction unit (read-out means) 110.

[0065]

File selection is done as follows. While a file in which white data to be used for MWB is written is being displayed on the monitor, a SELECT switch 708 is depressed to cause a white sheet data image selection unit 109 to select a desired one.

[0066]

As indicated by the reproduction monitor 701 in Fig. 7, if the image pickup date and place are written in a location except a white data recording area 702 when intentionally picking up an image used in MWB, operation for the white data can be further facilitated.

[0067]

In accordance with a signal indicating that the file is selected, the white sheet data image selection unit 109 selects the white sheet data of an image file being reproduced. A white balance control value operating unit 111 calculates a white balance control value on the basis of the white data.

[0068]

White balance calculations are done as follows. The ratio of average values of R, G1, G2, and B is calculated, and the reciprocal of the ratio of R and B using the G1 and G2 average values as the median is calculated as a white balance control values.

[0069]

A white balance control value setting unit 112 sets the resultant white balance control value as the MWB control value in the image pickup apparatus.

[0070]

When image pickup operation is performed using the MWB control value set as described above, a white balance adjustment unit 114 multiplies the set MWB control value with each color component, input from an image pickup data input terminal 113, of an image signal output from the image pickup element and converted into digital data, thereby adjusting the white balance.

[0071]

The white balance-adjusted signal undergoes color processing in a color processing unit 115 and encoding processing in an encoding processing unit 116. An image filing unit 117 converts the encoded image signal into an image file together with the white sheet data extracted from the image pickup data. A medium-recording unit 118 records the image file on a recording medium.

[0072]

As described above, there is provided a function of setting in the image pickup apparatus the MWB control value obtained from the white sheet data recorded together with the image pickup data in the image file. White data recorded in a plurality of scenes can easily be repeatedly used. Image pickup operation for setting an MWB control

value upon a change in scene need not be done, thereby facilitating the use of MWB adjustment.

[0073]

As described above, according to the first embodiment, a plurality of white sheet data can be managed using one medium and accessed easily, thereby improving convenience in use of MWB white sheet data.

[0074]

(Second Embodiment)

Fig. 2 is a block diagram showing the main part of an image pickup apparatus according to the second embodiment. This embodiment will explain a method of recording part of image pickup data as color adjustment data (to be referred to as color balance data hereinafter) of a picked-up image in a data area of each image file when recording each pickup image on a recording medium.

[0075]

Referring to Fig. 2, an image pickup data input terminal 201 receives image pickup data obtained by an image pickup element having four, R, G1, G2, and B, color filters and converted into digital data.

[0076]

This image pickup data is processed in a main image processing unit 202 with various image processing operations for recording with high image quality as in a digital image recording apparatus such as a general digital camera. The processed image pickup data is then encoded by an encoding

processing unit 203 in accordance with a JPEG recording format.

[0077]

On the other hand, part of the image pickup data, e.g., pixel data of 64 pixels in the central portion of the two-dimensional image space of one picture is extracted by a color balance data extraction unit 204, as shown in Fig. 9. An averaging processing unit 205 generates an average value of 16-pixel data of each color component signal of R, G1, G2, or B.

[0078]

An image filing unit 206 forms an image file into which the resultant average value is converted together with encoded image data. The average value is allocated to a predetermined color balance data area attached to an image file. A medium-recording unit 207 records the average value together with the original encoded image data as one image file on a recording medium.

[0079]

The above operation is always done in all image pickup operations including normal image pickup. Color balance image pickup is done as one of the general image pickup operations. Since color balance data is obtained by extracting an image of 64 pixels in the central portion of the picture, any color image except color balance data may be picked up around the 64-pixel area.

[0080]

A technique for setting in the image pickup apparatus a color balance control value used for color balance adjustment after white balance adjustment will be described below. A medium on which an image file is recorded by the above recording scheme is loaded in the image pickup apparatus, and image file reproduction is done using a user interface shown in Fig. 7.

[0081]

A PLAY button 703 shown in Fig. 7 is depressed to reproduce and display this image data of the image file, on a reproduction monitor 701.

[0082]

The operator sequentially switches a plurality of files with file selection switches 704 and 705 while viewing this reproduction motor 701 and an image 709 superposed on the pickup image. The operator then selects one image file to be used for color balance adjustment.

[0083]

When one image file is reproduced and monitored, a color balance data reproduction unit 210 reads out and reproduces the color balance data from the attached color balance data area.

[0084]

File selection is done as follows. While a file in which color balance data used for color balance adjustment is written is being displayed on the monitor, a SELECT switch 708 is depressed to cause a color balance data image selection

unit 209 to select a desired file.

[0085]

As indicated by the monitor 701 in Fig. 7, when the image pickup date and place are written in a location except a color balance data recording area 702 in intentionally picking up an image used for color balance adjustment, operation for the color balance data can be further facilitated.

[0086]

In accordance with an image file selection signal indicating that a file is selected, the color balance data image selection unit 209 extracts the color balance data of an image file being reproduced. A color balance control value operating unit 211 calculates a color balance control value.

[0087]

Color balance calculations are done as follows. The ratio of average values of R, G1, G2, and B is calculated, and the reciprocal of the ratio of R and B using the G1 and G2 average values as the median is calculated as a color balance control value.

[0088]

The color balance adjustment control value can be finely adjusted (changed) in the following manner.

[0089]

For example, adjustment in the R-B direction is performed using the switches 704 and 705 shown in Fig. 7.

Every time the switch 704 is depressed, a color balance adjustment coefficient unit 219 outputs an R sum signal. A color balance control value operating unit 211 adds a constant to the R control value and subtracts a constant from the B control value. Every time the switch 705 is depressed, the color balance adjustment coefficient unit 219 outputs a B sum signal. The color balance control value operating unit 211 adds a constant to the B control value and subtracts a constant from the R control value.

[0090]

Adjustment in the magenta-green direction is performed using switches 706 and 707 shown in Fig. 7. Every time the switch 706 is depressed, the color balance adjustment coefficient unit 219 outputs an R+B sum signal. The color balance control value operating unit 211 adds a constant to the R and B control values and subtracts a constant from the G1 and G2 control values. Every time the switch 705 is depressed, the color balance adjustment coefficient unit 219 outputs a Gr sum signal. The color balance control value operating unit 211 adds a constant to the G1 and G2 control values and subtracts a constant from the R and B control values.

[0091]

The R, G, and B signals for adjusting the output signals of a monitor (not shown) can be similarly controlled by the signals from the color balance adjustment coefficient unit 219 to allow the operator to confirm the fine adjustment

on the monitor.

[0092]

The color balance control values obtained as described above are set in the image pickup apparatus as the color balance adjustment control values by a color balance control value setting unit 212.

[0093]

As described above, when image pickup operation is performed using the color balance adjustment control values thus set, an auto white balance adjustment unit 219 adjusts the white balance of each color component of a digital image signal input from an image pickup data input terminal 213 via an image pickup element. A color balance adjustment unit 214 multiplies the set color balance control value with each color component, thereby adjusting the color balance.

[0094]

For example, when an image has a uniform red portion in its center, a reddish image is output since this reddish tincture is reflected on the output image.

[0095]

The color balance-adjusted signal undergoes color processing in a color processing unit 215 and encoding processing in an encoding processing unit 216. An image filing unit 217 converts the encoded image signal into an image file together with the color balance data extracted from the image pickup data. A medium-recording unit 218

records the image file on a recording medium.

[0096]

As described above, there is provided a function of setting in the image pickup apparatus the color balance adjustment control value obtained from the color balance data recorded together with the image pickup data in the image file. Color balance data recorded in a plurality of scenes can be easily selected and repeatedly used. The user can freely express an image by easily changing the color tincture of the pickup image.

[0097]

As described above, according to the second embodiment, color balance data recorded in a plurality of scenes can be easily selected and repeatedly used. The user can freely change the color balance of the auto white balance-adjusted pickup image. The user can freely express an image by easily changing the color tincture of the pickup image.

[0098]

(Third Embodiment)

Fig. 3 is a block diagram showing the main part of an image pickup apparatus according to the third embodiment. This embodiment will explain a method of recording part of image pickup data as white sheet data or color balance data of a picked-up image in a data area of each image file when recording each pickup image on a recording medium, and using these data for MWB adjustment and color balance

adjustment.

[0099]

Referring to Fig. 3, an image pickup data input terminal 301 receives image pickup data obtained by an image pickup element (image pickup means) having four, R, G1, G2, and B, color filters and converted into digital data.

[0100]

This image pickup data is processed in a main image processing unit 302 for various image processing operations for recording with high image quality as in a digital image recording apparatus such as a general digital camera. The processed image pickup data is then encoded by an encoding processing unit 303 in accordance with a JPEG recording format.

[0101]

On the other hand, part of the image pickup data, e.g., pixel data of 64 pixels in the central portion of the two-dimensional image space of one picture is extracted by an image data extraction unit 304, as shown in Fig. 9. An averaging processing unit 305 generates an average value of 16-pixel data of each color component signal of R, G1, G2, or B.

[0102]

An image filing unit 306 forms an image file into which the resultant average value is converted together with encoded image data. The average value is allocated to a predetermined area attached to an image file. A

medium-recording unit (recording means) 307 records the average value together with the original encoded image data as one image file on a recording medium.

[0103]

The above operation is always done in all image pickup operations including normal image pickup. Each of white sheet data image pickup and color balance image pickup is done as one of the general image pickup operations. Since the white sheet data and color balance data are obtained by extracting an image of 64 pixels in the central portion of the picture, any image except white sheet data and color balance data may be picked up around the 64-pixel area.

[0104]

A technique for setting in the image pickup apparatus an MWB control value used for MWB adjustment and a color balance control value used for color balance adjustment will be described below. A medium on which an image file is recorded by the above recording scheme is loaded in the image pickup apparatus, and image file reproduction is done using a user interface shown in Fig. 8.

[0105]

A PLAY button 803 shown in Fig. 8 is depressed to reproduce and display this image data (image pickup data) of the image file on a reproduction monitor 801.

[0106]

The operator sequentially switches a plurality of files with file selection switches 804 and 805 while viewing

this reproduction motor 801 and a white image or color adjustment image 810 superposed on the pickup image. The operator then selects an image file to be used for white balance adjustment.

[0107]

When one image file is reproduced and monitored, a selection data reproduction unit 310 reads out and reproduces the white sheet data from the attached data area.

[0108]

File selection is done as follows. While a file in which white balance data used for white balance adjustment is written is being displayed on the monitor, a WHITE switch 808 is depressed to cause a CB/WB adjustment image selection unit (first selection means) 309 to select a desired file.

[0109]

As indicated by the monitor 801 shown in Fig. 8, if the image pickup date and place are written in a location except a white balance data recording area 802 when intentionally picking up an image used for white balance adjustment, operation for the white sheet data can be further facilitated. This also applies to color balance adjustment to be described later.

[0110]

The attached data of the image file being reproduced is selected by the CB/WB adjustment image selection unit 309 in accordance with the file selection signal indicating that a file is selected. Upon depressing the White switch

808, a switch 321 is switched in accordance with a signal from a CB/WB selection unit 320 for switching between white balance data and the color balance data. A white balance control value operating unit 311 calculates a white balance control value using the selected data.

[0111]

White balance calculations are done as follows. The ratio of average values of R, G1, G2, and B is calculated, and the reciprocal of the ratio of R and B using the G1 and G2 average values as the median is calculated as a white balance control value.

[0112]

The white balance adjustment control value can be set in the image pickup apparatus as the MWB adjustment control value by a CB/WB control value setting unit 313.

[0113]

When the MWB control value is set in the image pickup apparatus, a color balance control value is calculated in the same manner as in the MWB control value and set in the image pickup apparatus.

[0114]

The PLAY button 803 shown in Fig. 8 is depressed to cause a medium-reproduction unit 308 to reproduce and display image pickup data on a reproduction monitor 701.

[0115]

The operator sequentially switches a plurality of files with file selection switches 804 and 805 while viewing

the pickup image displayed on the reproduction motor 801. The operator then selects one image file desired to be used for color balance adjustment.

[0116]

While the image file is reproduced and monitored, a selection data reproduction unit 310 reads out the color balance data from the attached data area and reproduces it on the monitor 701.

[0117]

File selection is done as follows. While a file in which data desired to be used for color balance adjustment is being displayed on the monitor, a COLOR switch 809 is depressed to cause the CB/WB adjustment image selection unit 309 to select a desired file.

[0118]

In accordance with the file selection signal indicating that a file is selected, the CB/WB adjustment image selection unit 309 selects the attached data of the image file being reproduced. Upon depressing the COLOR switch 809, the switch 321 is switched in accordance with the WB/CB selection unit 320 for switching between the white balance data and the color balance data. A color balance control value operating unit 312 calculates a color balance control value using the selected data.

[0119]

Color balance calculations are done as follows. The ratio of average values of R, G1, G2, and B is calculated,

and the reciprocal of the ratio of R and B using the G1 and G2 average values as the median is calculated as a color balance control value.

[0120]

The color balance adjustment control value can be finely adjusted in accordance with a signal from a color balance adjustment coefficient unit 322 as in the second embodiment.

[0121]

The color balance control values thus obtained are set in the image pickup apparatus by the CB/WB control value setting unit 313 as the color balance adjustment control values.

[0122]

When image pickup operation is performed using the white balance adjustment control value and color balance adjustment control value set as described above, a white balance adjustment unit 320 performs MWB adjustment for each color component of a digital image signal input from an image pickup data input terminal 314 via an image pickup element, thereby adjusting the white balance.

[0123]

A color balance adjustment unit 315 then performs color balance adjustment. The set color balance control value is multiplied with each color component to perform color balance adjustment.

[0124]

The color balance-adjusted signal undergoes color processing in a color processing unit 316 and encoding processing in an encoding processing unit 317. An image filing unit 318 converts the encoded image signal into an image file together with the white sheet data and color balance data extracted from the image pickup data. A medium-recording unit 319 records the image file on a recording medium.

[0125]

As described above, there is provided a function of setting in the image pickup apparatus the MWB adjustment control value and color balance adjustment control value obtained from the color balance data recorded together with the image pickup data in the image file. Attached data of image files recorded in a plurality of scenes can be easily selected and repeatedly used. The user can freely express an image by easily changing the color tincture of the pickup image.

[0126]

More specifically, MWB white sheet data is read out to perform white balance adjustment. The same white sheet data or another white sheet data also can be read out to perform color balance adjustment. Thus, the color tone of the pickup image can be freely controlled.

[0127]

Thus, according to the third embodiment, MWB white sheet data is read out to perform white balance adjustment.

The same white sheet data or another white sheet data also can be read out to perform color balance adjustment. Thus, attached data of image files recorded in a plurality of scenes can be easily selected and repeatedly used. The user can freely express an image by easily changing the color tincture of the pickup image.

[0128]

(Fourth Embodiment)

Fig. 4 is a block diagram showing the main part of an image pickup apparatus according to the fourth embodiment. This embodiment will explain a method of recording part of picked-up image as gain control data for MWB and color balance adjustment in an attached data area of each image file, performing adjustment operation so as to use the gain adjustment data in any image pickup apparatus and perform MWB adjustment and color balance adjustment in recording each pickup image on a recording medium.

[0129]

A method of extracting some data from image pickup data and recording the extracted data as data for MWB or color balance adjustment in an attached area of each image file is the same as in the first embodiment, and a detailed description thereof will be omitted.

[0130]

According to the characteristic feature of the fourth embodiment, image pickup element fluctuation adjustment data recorded in an image pickup element fluctuation

adjustment data recording area (memory) or adjustment data unit 419 of this image file as data obtained by picking up images of a white sheet under each of two different specific light sources are recorded in a specific part of the attached area.

[0131]

Image pickup element fluctuation adjustment data, i.e., image pickup data 1203 and 1205 of two different light sources obtained by using a reference image pickup apparatus shown in Fig. 10 and image pickup data 1204 and 1206 of two different light sources unique to each image pickup apparatus for each color component of R, G1, G2, or B, are recorded by the adjustment data unit (memory) 419 in the area attached to the image file. This embodiment uses two different light sources. However, adjustment precision is improved when the number of types of light sources increases. Although the adjustment precision is not improved so much, the image pickup element fluctuation adjustment can be also attained by using only one kind of light source.

[0132]

These image pickup element fluctuation adjustment data which is written in the memory of each image pickup apparatus at the time of shipment, are read out by a readout means (not shown) (second readout means) in each image pickup operation and then written in a single file together with the MWB white sheet data and color balance data.

[0133]

The average value of all or some image pickup data for each color component of R, G1, G2, or B, obtained when picking up the image of a light source, is used as such image pickup element fluctuation adjustment operation data.

[0134]

As in the above three embodiments, when the attached data of a file selected by a selection data reproduction unit 410 shown in Fig. 4 is read out, the fluctuation adjustment data are also read out and reproduced.

[0135]

An adjustment operation unit 420 adjusts these fluctuation adjustment data in the following manner and supplies the resultant data as R, G1, G2, and B data for MWB or color balance adjustment to a gain control value operating unit 4111. The gain control value operating unit 4111 calculates gain control values for MWB and color balance adjustment.

[0136]

Referring to Fig. 10, an image pickup apparatus 1201 records MWB and color balance adjustment data on a medium. An image pickup apparatus 1202 reads out the MWB and color balance gain adjustment data recorded on the recording medium and performs gain adjustment.

[0137]

Fluctuation adjustment between the image pickup elements in an image pickup apparatus is two-dimensionally performed using ratios R/B and (R+B)/(G1+G2) of reference

data Rrefa, G1refa, G2refa, Brefa of a light source a, reference data Rrefb, G1refb, G2refb, and Brefb of a light source b, and data Ra, G1a, G2a, and Ba of the light source a, and data RbS, G1bS, G2bS and BbS of the light source b which are unique to the image pickup apparatus.

[0138]

The method of fluctuation adjustment calculation between the image pickup elements in an image pickup apparatus can be expressed by a difference such as an (R-B) value or (R+B) - (G1+G2) value. Any mathematical expression can be used if it can be expressed so as to absorb fluctuations between the image pickup elements in the image pickup apparatus.

[0139]

First of all, the relationship between the reference data RrefaS, G1refaS, G2refaS, BrefaS, RrefbS, G1refbS, G2refbS, and BrefbS (1203) read out from a given recording medium and adjustment data RaS, G1aS, G2aS, BaS, RbS, G1bS, G2bS, and BbS (1204) unique to the image pickup apparatus and recorded on the given recording medium is adjusted using MWB and color balance gain adjustment data R, G1, G2, and B read out from the given recording medium.

[0140]

Gain values and offset values of the difference between the R/B ratios and (R+B)/(G1+G2) ratios of the light sources a and b are obtained:

[0141]

$$GainRB = \{(RrefaS/BrefaS) - (RrefbS/BrefbS)\}/\{(RaS/BaS) - (RbS/BbS)\} \quad \ldots(1)$$

$$OffsetRB = (RrefaS/BrefaS) - GainRB*(RaS/BaS) \quad \ldots(2)$$

These are reflected on the gain adjustment data.

[0142]

$$(R'/B') = GainRB*(R/B) + OffsetRB \quad \ldots(3)$$

Similarly, the following relations are obtained for the (R+B)/(G1+G2) ratios:

$$GainRBG1G2 = \{(RrefaS+BrefaS)/(G1refaS+G2refaS) - (RrefbS+BrefbS)/(G1refbS+G2refbS)\}/\{(RaS+BaS)/(G1aS+G2aS) - (RbS+BbS)/(G1bS+G2bS)\} \quad \ldots(4)$$

$$OffsetRBG1G2 = (RrefaS+BrefaS)/(G1refaS+G2refaS)\} - GainRBG1G2*\{(RaS+BaS)/(G1aS+G2aS)\} \quad \ldots(5)$$

$$(R'+B')/(G1'+G2') = GainRBG1G2*\{(R+B)/(G1+G2)\} + OffsetRBG1G2 \quad \ldots(6)$$

These equations yield data converted into reference data for the image pickup apparatus which recorded the data on the medium. This is the adjustment operation 1207.

[0143]

The adjustment operation (2) 1208 and the adjustment operation (3) 1209 are obtained from the equations for obtaining the completely same gain values and offset values in the adjustment operation (1) 1207.

[0144]

Now it is assumed that (R''/B''), (R''+B'')/(G1''+G2'') can be calculated from the adjustment operation (2) for calculating (R'/B'), (R'+B')/(G1'+G2'), and (R'''/B'''), (R'''+B''')/(G1'''+G2''') can be calculated from the adjustment operation (3) for calculating (R''/B''), (R''+B'')/(G1''+G2'').

[0145]

Since G1''' and G2''' are the center of the RG1G2 ratio, they are made to equal to the G1aD and G2aD values of an image pickup apparatus 202 (medium-use-side image pickup apparatus D). Thus, R''' and B''' values can be calculated.

[0146]

The R''', G1''', G2''', and B''' values thus obtained represent values which absorb fluctuations between the image pickup elements in the image pickup apparatuses 1201 and 1202 upon converting the data of the image pickup apparatus 1201 (medium-providing-side image pickup apparatus S) into data of the image pickup apparatus 1202 (medium-use-side image pickup apparatus D).

[0147]

The gain adjustment control value operation unit 411 calculates the ratio of R''', G1''', G2''', and B''' from the values obtained by the arithmetic operations (1), (2) and (3) and obtains the MWB and color balance adjustment control values. Then, the gain control value setting unit

(setting means) 412 performs settings.

[0148]

Using the gain adjustment control values thus set, the gain adjustment unit 414 performs MWB or color balance adjustment in the subsequent image pickup. The data are converted into an image file as in the above embodiments. The resultant data is recorded on a recording medium by a medium-recording unit 418.

[0149]

By the above method, data written in the specific area attached to the image file used for MWB and color balance adjustment is adjusted for fluctuations using the image pickup element fluctuation adjustment operation data of the image pickup apparatus, written in the same specific area. Thus, as long as identical light sources are used, the same R, G, G1, and B values are obtained even when different image pickup apparatus are used. Therefore, data fluctuations between the image pickup apparatuses can be absorbed.

[0150]

As described above, even if MWB or color balance control values are obtained using the white sheet data or color balance adjustment data of image files picked up using different image pickup apparatuses, optimal (accurate) MWB or color balance adjustment operation can be done.

[0151]

According to the fourth embodiment, as described

above, white balance adjustment or color balance adjustment using white sheet data can be accurately done in an image pickup apparatus different from that by which the white sheet data are obtained.

[0152]

In the first to fourth embodiments, the colors of the color filters of the image pickup element are R, G1, G2, and B. However, the present invention is also applicable to complementary color filters of Mg (magenta), Gr (green), Cy (cyan), and Ye (yellow) components, as shown in Fig. 6.

[0153]

The object of the present invention is realized even by supplying a storage medium storing software program codes for realizing the functions of the above-described embodiments to a system or an apparatus, and causing the computer (or a CPU or an MPU) of the system or the apparatus to read out and execute the program codes stored in the storage medium.

In this case, the program codes read out from the storage medium realize the functions of the above-described embodiments by themselves, and the storage medium storing the program codes therefore constitutes the present invention.

[0154]

As a storage medium for supplying the program codes, a floppy disk, a hard disk, an optical disk, a magnetooptical disk, a CD-ROM, a CD-R, a magnetic tape, a nonvolatile memory

card, a ROM, or the like can be used.

The functions of the above-described embodiments are realized not only when the readout program codes are executed by the computer but also when the OS (Operating System) running on the computer performs part or all of actual processing on the basis of the instructions of the program codes.

[0155]

The functions of the above-described embodiments are also realized when the program codes read out from the storage medium are written in the memory of a function expansion board inserted into the computer or a function expansion unit connected to the computer, and the CPU of the function expansion board or function expansion unit performs part or all of actual processing on the basis of the instructions of the program codes.

[0156]

When the present invention is applied to the above storage medium, program codes corresponding to the flow chart described above are stored in the storage medium. Briefly speaking, modules indispensable to the image pickup apparatus of each embodiment described above are stored in the storage medium.

[0157]

[Effect of the Invention]

As has been described above, according to the present invention, convenience of the white sheet data used for

color correction of a picked-up image can be improved.

[Brief Description of the Drawings]

[Figure 1]

A block diagram showing the main part of an image pickup apparatus according to the first embodiment.

[Figure 2]

A block diagram showing the main part of an image pickup apparatus according to the second embodiment.

[Figure 3]

A block diagram showing the main part of an image pickup apparatus according to the third embodiment.

[Figure 4]

A block diagram showing the main part of an image pickup apparatus according to the fourth embodiment.

[Figure 5]

A view showing the structure of primary color filter arrays of image pickup elements.

[Figure 6]

A view showing the structure of complementary color filter arrays of image pickup elements.

[Figure 7]

A view showing the arrangement of a user interface according to the first and second embodiments.

[Figure 8]

A view showing the arrangement of a user interface according to the third embodiment.

[Figure 9]

A view showing image pickup data to be extracted according to the first to fourth embodiments.

[Figure 10]

A view for explaining the order of operation for adjusting variations in image pickup elements according to the fourth embodiment.

[Figure 11]

A block diagram showing a prior art.

[Figure 12]

A block diagram showing another prior art.

[Description of Reference Numerals or Symbols]

104 ... white sheet data extraction unit

107 ... medium-recording unit

109 ... white sheet data image selection unit

110 ... white sheet data reproduction unit

111 ... white balance control value operating unit

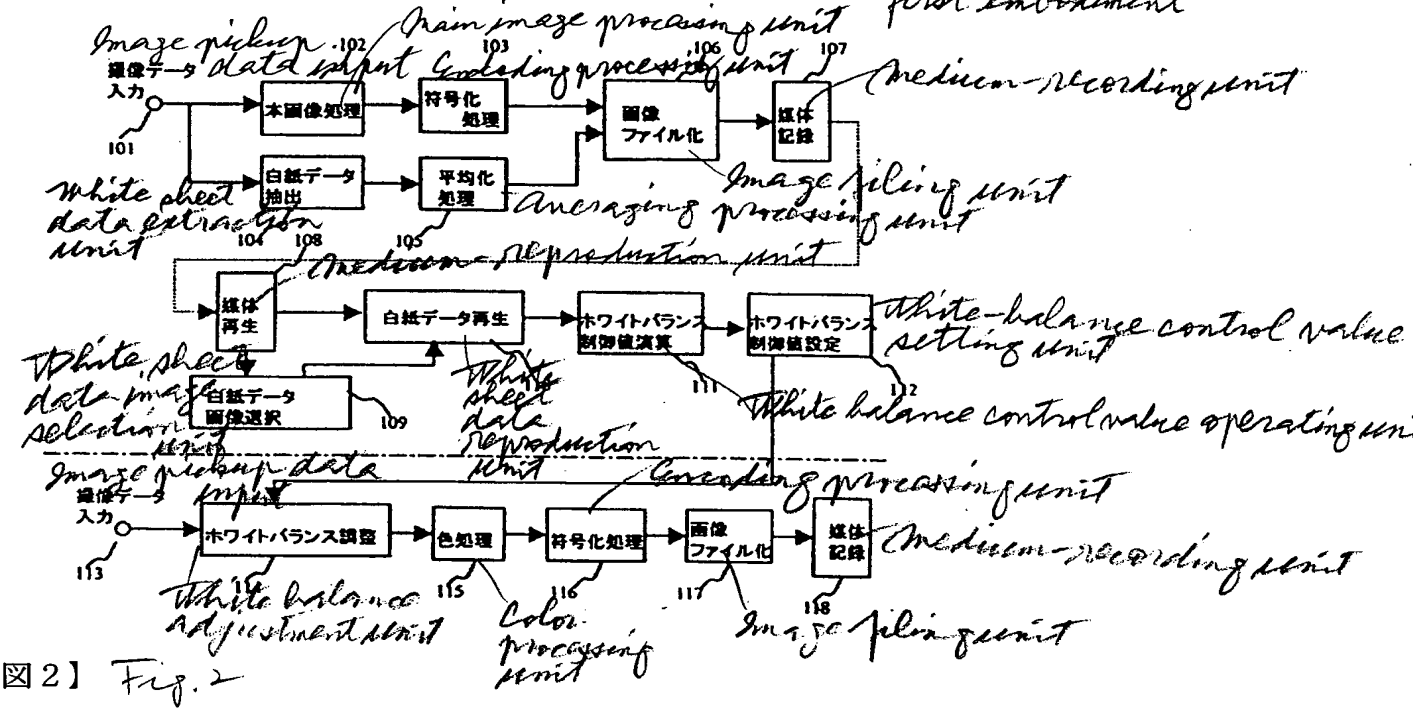
112 ... white balance control value setting unit

114 ... white balance adjustment unit

【書類名】　図面　[Name of the Document] Drawings

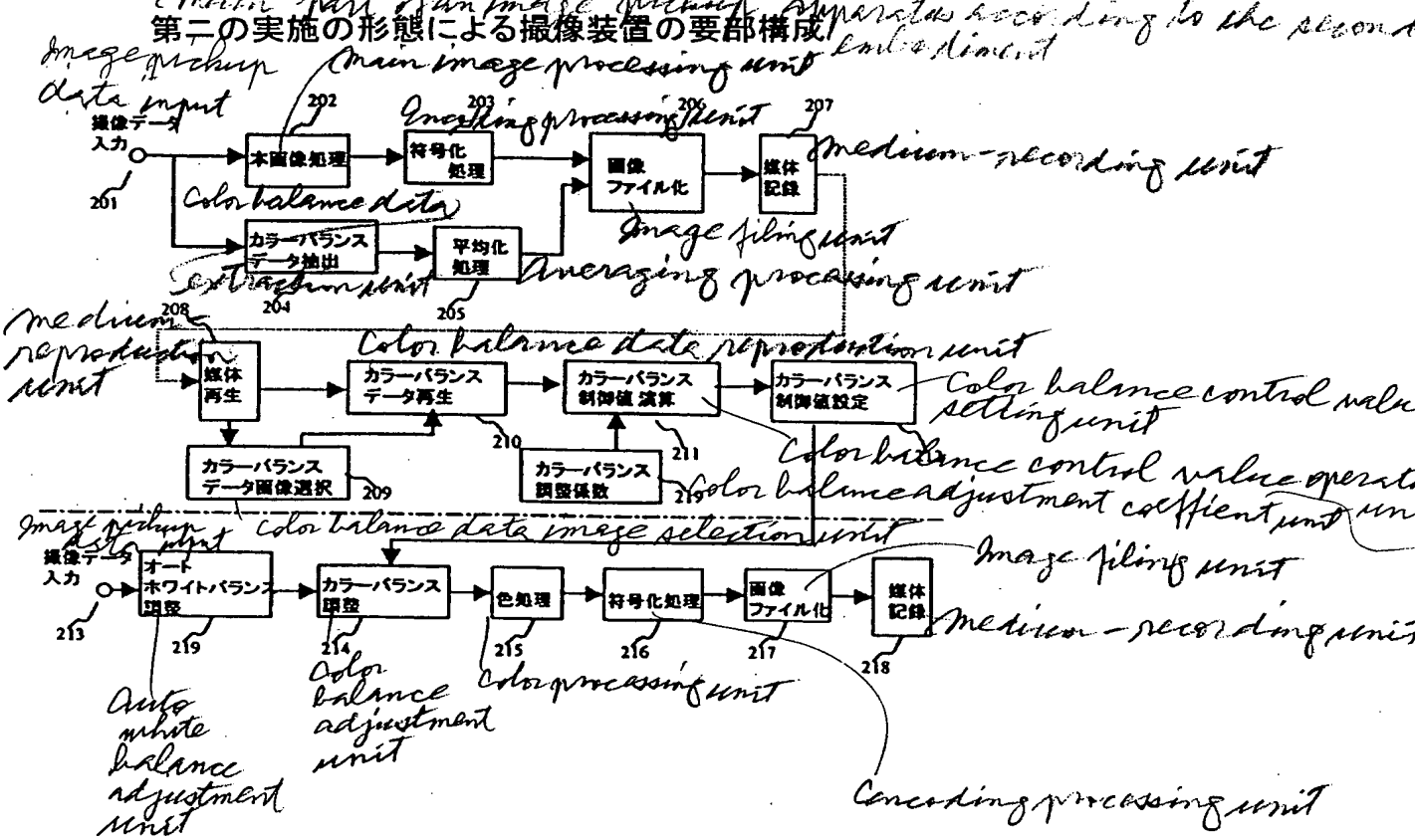
【図１】　Fig. 1

第一の実施の形態による撮像装置の要部構成
Main part of an image pickup apparatus according to the first embodiment



【図２】　Fig. 2

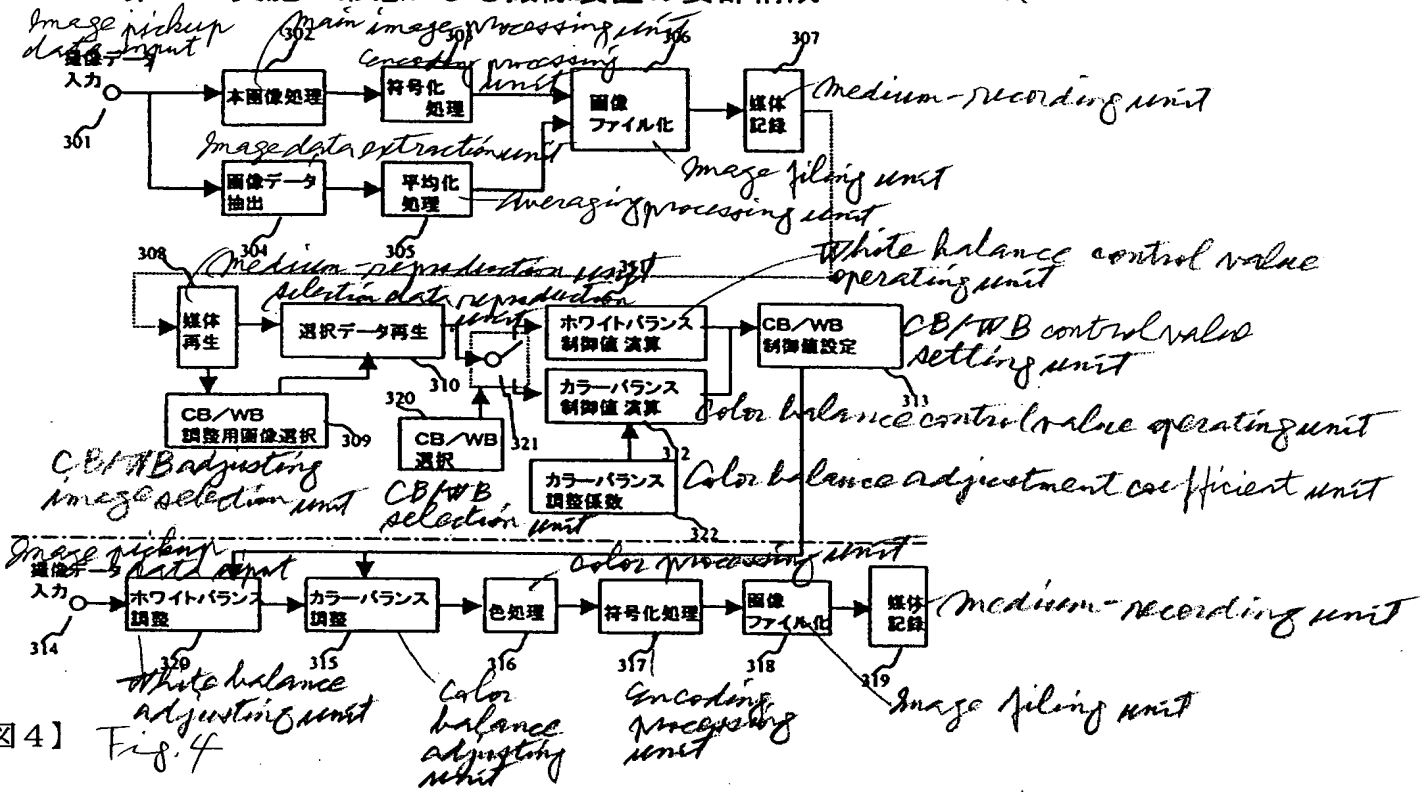
第二の実施の形態による撮像装置の要部構成
Main part of an image pickup apparatus according to the second embodiment



【図３】　Fig. 3

第三の実施の形態による撮像装置の要部構成

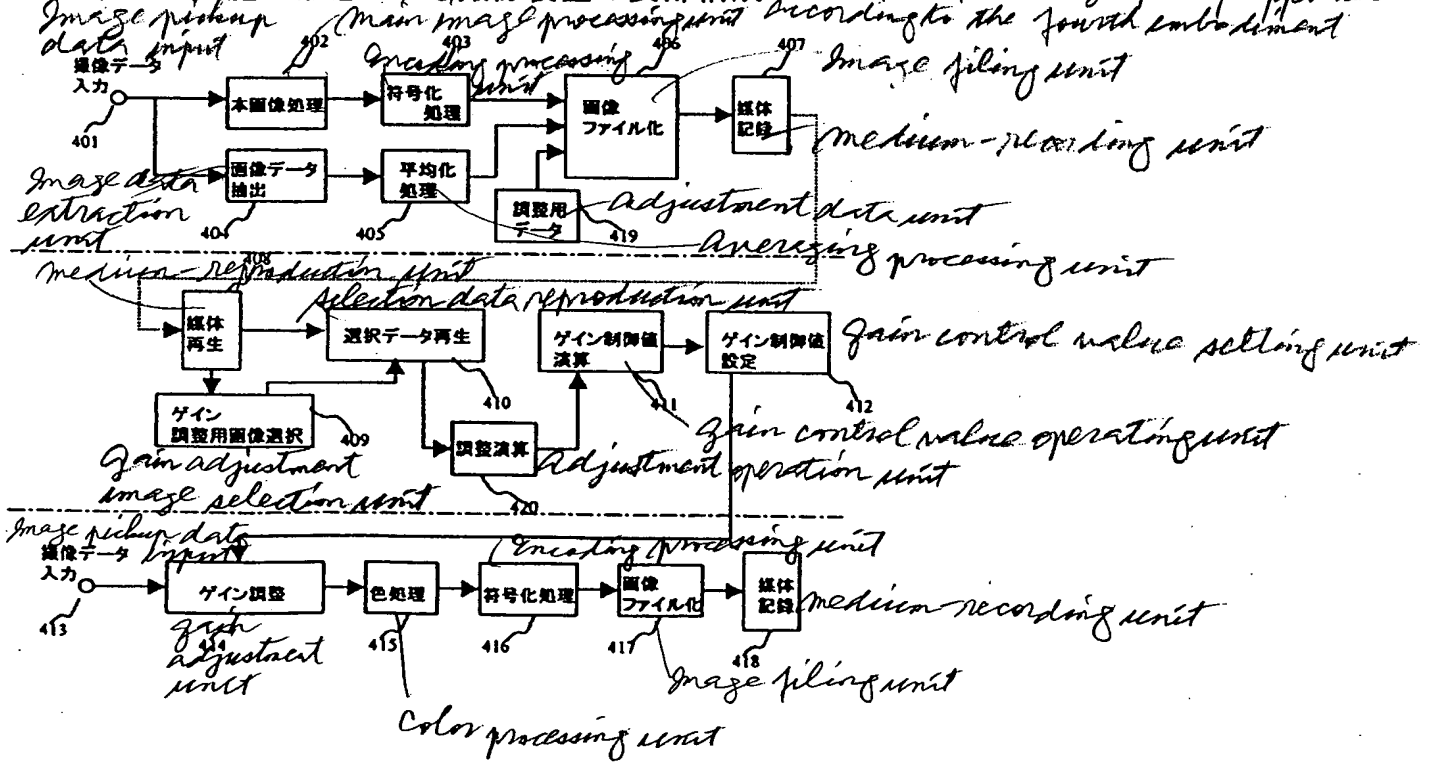
Main part of an image pickup apparatus according to the third embodiment



【図４】　Fig. 4

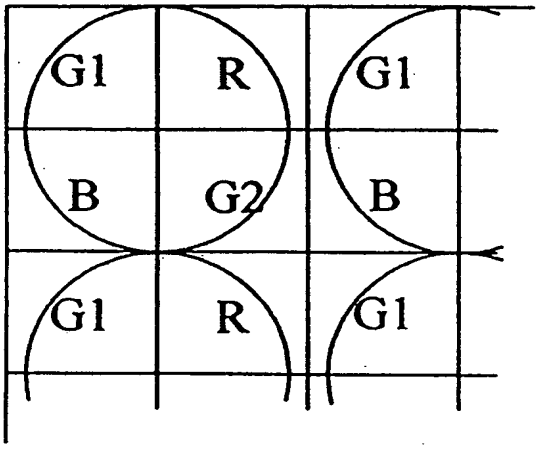
第四の実施の形態による撮像装置の要部構成

Main part of an image pickup apparatus according to the fourth embodiment



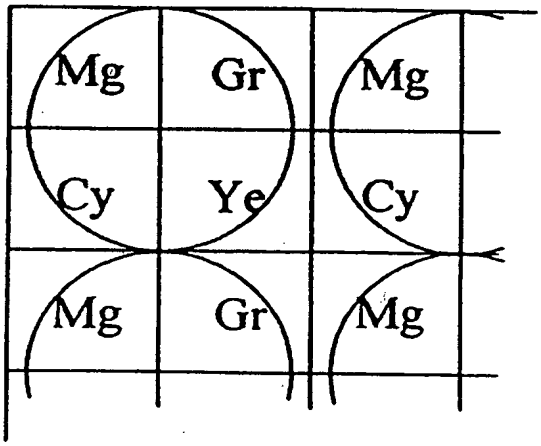
【図５】 Fig. 5

撮像素子の原色フィルターの配列構成
Primary color filter array structure of image pickup apparatus



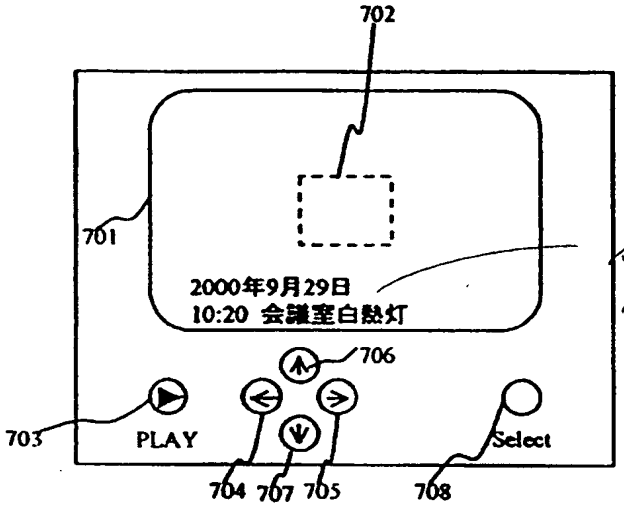
【図６】 Fig. 6

撮像素子の補色フィルターの配列構成
Complementary color filter array structure of image pickup apparatus



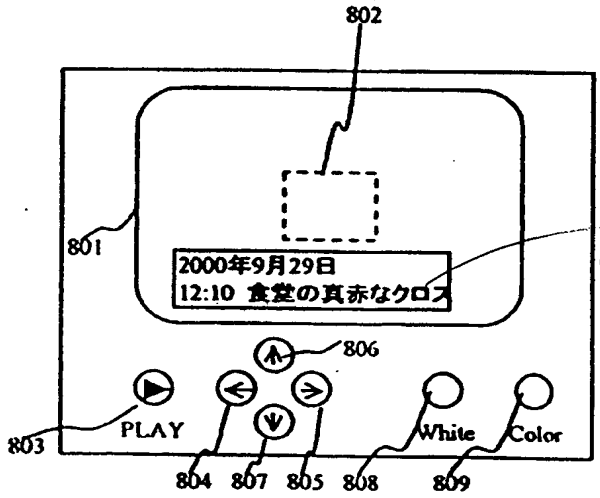
【図７】 Fig. 7

第一，第二の実施の形態によるユーザーインターフェースの構成 arrangement of user interface according to the first and second embodiments



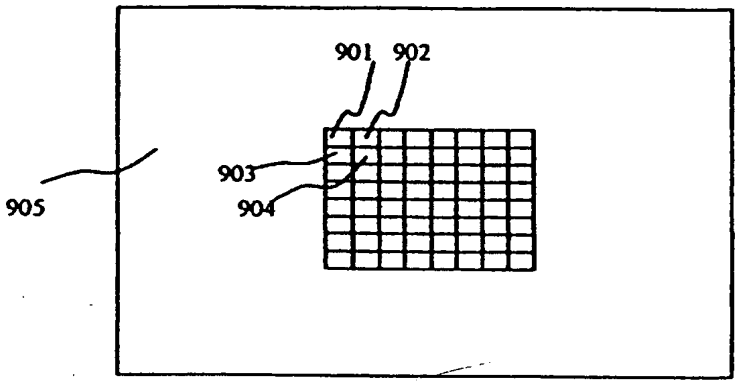
【図８】 Fig. 8

第三の実施の形態によるユーザーインターフェースの構成 arrangement of user interface according to the third embodiment



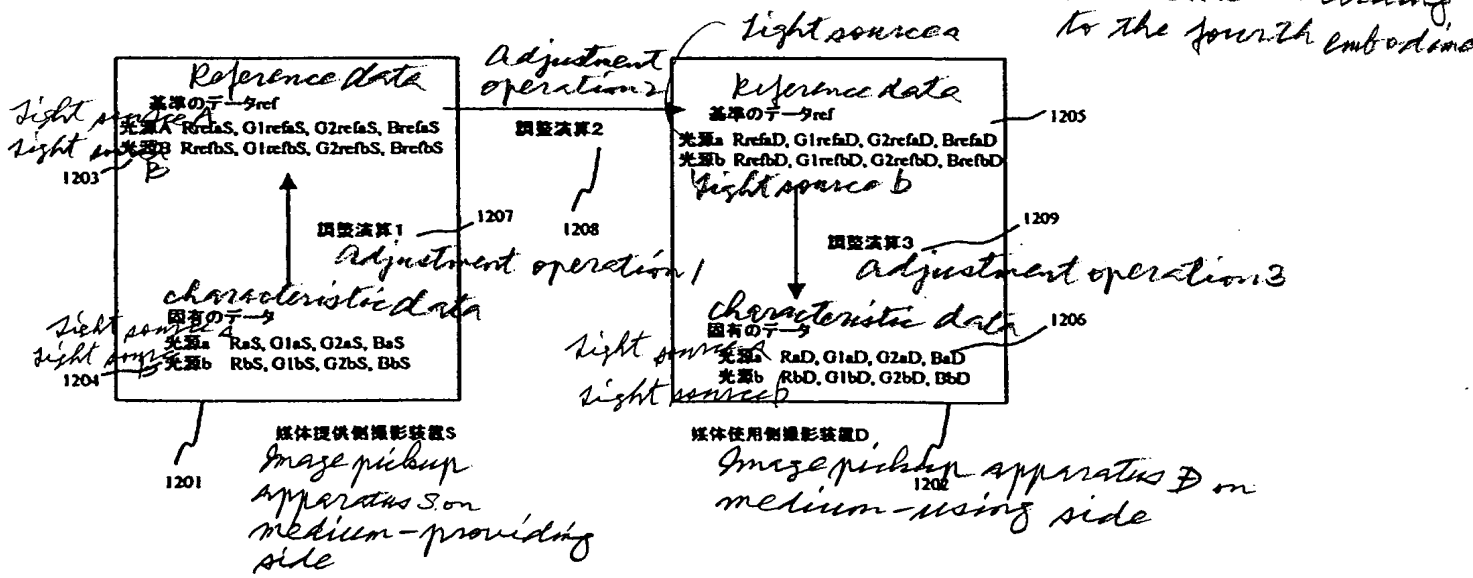
【図９】 Fig. 9

第一～第四の実施の形態による抽出される撮像データ Image pickup data to be extracted according to the first to fourth embodiments

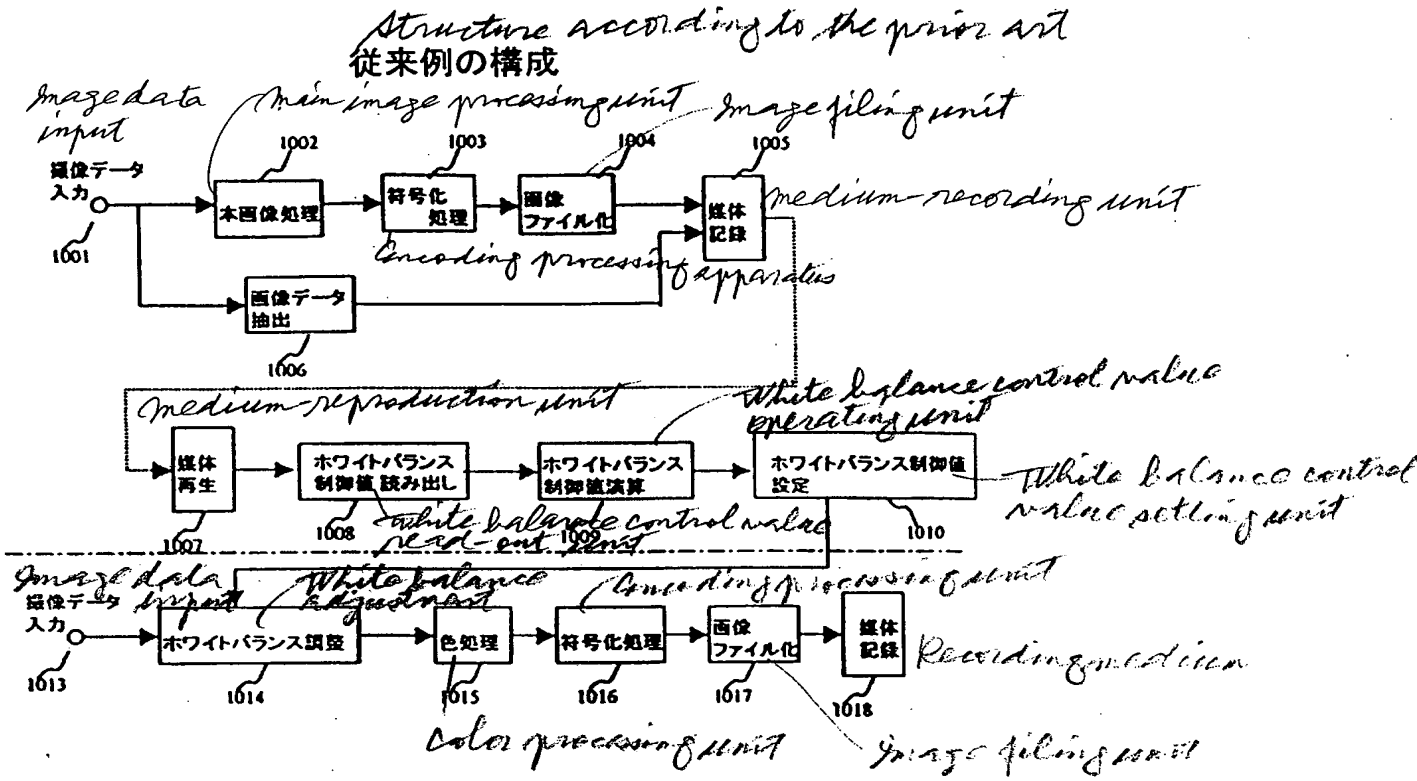


【図１０】 Fig. 10

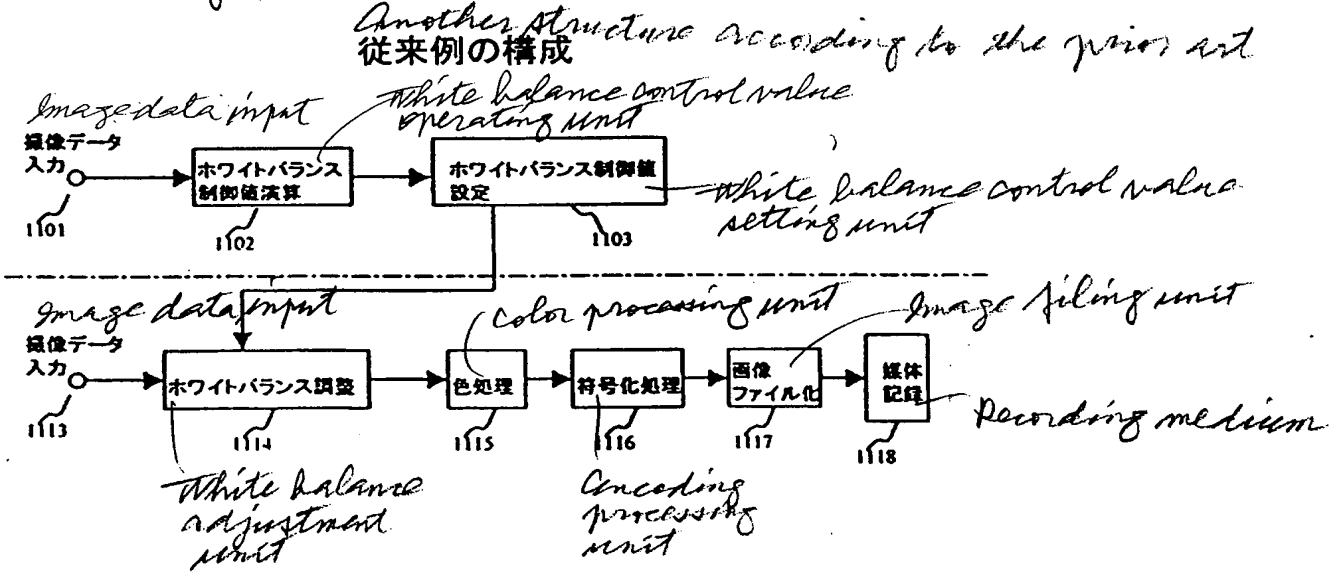
第四の実施の形態による撮像素子のバラツキを調整する演算の順序 Order of operation for adjusting variations in image pickup elements according to the fourth embodiment



【図１１】　Fig. 11



【図１２】　Fig. 12



[Name of the Document] Abstract

[Abstract]

[Object]

An object of the present invention is to provide an image pickup apparatus in which convenience of the white sheet data used for color correction of a picked-up image can be improved.

[Means for Achieving the Object]

Each input image pickup data is converted into a file by an image filing unit 106 and recorded by a medium-recording unit 107. Average value data of each color component data for part of this picked-up data is stored in an area different from the image pickup data recording area in each file. When desired image pickup data is selected by a white sheet data image selection unit 109 by the use of a monitor for reproducing and displaying the image pickup data, the average value data stored in the same file as the image pickup data is read out by a white sheet data reproduction unit 110. A control value of a white balance adjustment unit 114 is calculated by a white balance control value operating unit 111 on this basis of the data. This control value is set by a white balance control value setting unit 112, and white balance adjustment is performed by the use of the set control value.

[Elected Drawing]

Figure 1